ABSTRACT

The increasing number of people with diabetes mellitus demands a more practical, convenient, and routine-friendly method for monitoring blood glucose levels. Conventional invasive methods, which require blood sampling, often cause discomfort and carry a risk of infection. Therefore, this study designed a non-invasive blood glucose measurement system based on infrared spectroscopy with a wavelength of 1000 nm, intended as a safe, portable, and highly accurate alternative.

This research developed a non-invasive blood glucose measurement system using a 1000 nm IR LED as the light source and a photodiode as the receiving sensor. The signal from the photodiode is amplified by an LM358 operational amplifier, converted via an external ADS1115 ADC, and processed by an ESP32 microcontroller. Sensor data is transmitted to an XGBoost regression model via a Flask API and displayed on both an LCD and a web interface.

The XGBoost model demonstrated excellent predictive performance, with K-Fold Cross Validation (k=2) results showing R^2 = 0.907, MAE = 1.23 mg/dL, and MSE = 33.11, where all predictions were within the ±15 mg/dL tolerance in accordance with ISO 15197:2013 standards. Conversely, the model without temperature and skin-type features recorded the second-lowest R^2 (0.839) and significantly higher MAE (1.75) and MSE (53.46) values. The model using only temperature showed the poorest performance, with the lowest R^2 (0.695), the highest MAE (3.32), and the largest MSE (100.65), indicating that temperature alone is insufficient for accurate prediction. Meanwhile, the model using only skin type achieved relatively good performance, with R^2 = 0.873, MAE = 1.39, and MSE = 44.99, showing that skin type had a stronger influence than ambient temperature on prediction accuracy.

Keywords: *XGBoost, blood glucose, non-invasive, ambient temperature, skin type, prediction.*